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First discovery of *Megischus* Brullé (Hymenoptera, Stephanidae) in Ryukyu Islands, with description of a new species

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Abstract

The first discovery of the genus *Megischus* Brullé, 1846 (Hymenoptera: Stephanidae) from Ryukyu Islands is reported and *Megischus baogong* Ge & Tan, **sp. nov.**, is described and illustrated.

Keywords

crown wasps, new species, parasitoids

Introduction

The crown wasp family Stephanidae Leach, 1815, is a parasitoid taxon of Hymenoptera, consisting of 10 extant genera and 366 species with a cosmopolitan distribution but mainly restricted to subtropical and tropical areas (van Achterberg 2002; Aguiar 2004,

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2006; Aguiar et al. 2010; Hong et al. 2010, 2011; Tan et al. 2015a, b, 2018; Chen et al. 2016; Moghaddam et al. 2019; Binoy et al. 2020; Gupta and Gawas 2020; Ge et al. 2021a, b). They parasitize wood-boring larvae of Cerambycidae, Buprestidae, Curculionidae and even Siricidae (Königsmann 1978; van Achterberg 2002; Aguiar 2004). Although most species are rarely collected, a few species has been released as biological control agents, e.g. *Schlettererius cinctipes* in biological control programs implemented against *Sirex noctilio* in Victoria, Australia from 1970 to 2006 (Collett and Elms 2010). The genus *Megischus* contains 88 species worldwide (van Achterberg 2002; van Achterberg and Yang 2004; Hong et al. 2010, 2011; Binoy et al. 2020; Ge et al. 2021a), and includes the largest species of Stephanidae, viz., *Megischus kuafu* Ge & Tan, 2021, with body length of 39.1 mm (excluding ovipositor; length of ovipositor sheath 59 mm). The knowledge of the biology of *Megischus* species is limited. For instance, *Megischus ptosimae* was reported as a parasitoid of larvae of *Ptosima chinensis* Mars. in peach trees (Chao 1964). Stephanidae are characterized by their modified legs, especially the unique morphology of hind legs. The subgenual organ of *Megischus* is suspended between a spine and a ridge internally and part of the tibial wall is thinner in the region of the subgenual organ in the mid and hind legs, likely used by females to detect substrate-borne vibrations from the host larva (Vilhelmsen et al. 2008).

The Ryukyu islands, an arc-shaped chain between China and Japan, as the boundary between East China Sea and the Philippine Sea, have a subtropical marine monsoon climate. However, biodiversity has not been well studied. Up to now, there is only one species of Stephanidae known in the islands. Here we report the second one, *Megischus baogong* Ge & Tan, sp. nov., from the Amami-Oshima island. This is the first record of the genus *Megischus* in the Ryukyu Islands, and also a new genus record and the sixth species known from Japan and it's control area (Watanabe and van Achterberg 2014; Watanabe K et al. 2015), i.e. *Foenatopus cinctus* (Matsumura, 1918) (Ryukyu Islands), *Foenatopus cervinus* Townes, 1958 (Ogasawara Islands), *Schlettererius cinctipes* (Cresson, 1880) (Honshu), *Stephanus anijimensis* Watanabe & van Achterberg, 2014 (Ogasawara Islands) and *Parastephanellus matsumotoi* van Achterberg, 2006 (Honshu).

Materials and methods

The genera of Stephanidae were identified following, van Achterberg (2002) and Hong et al. (2011).

Observations and descriptions were made with a Leica M205A stereomicroscope, Photographic images were made with the Keyence VHX-5000 digital microscope. Morphological terminology follows van Achterberg (2002) including the abbreviations for the wing venation. The types are deposited in the College of Forest Protection, Beijing Forestry University (**BFU**) and Northwest University, Xi'an (**NWUX**), China.

Taxonomy

Key to Stephanidae species of Ryukyu Islands

1 Neck with pronotal fold absent; veins 2-SR and 2-SR+M of fore wing absent; vein 1-SR absent or faintly developed. Small size (length of body less than 15 mm). Temple with pale yellowish streak behind eye. Okinawa Is (genus *Foenatopus*) ..... ***Foenatopus cinctus* (Matsumura, 1918)**

– Neck elongate and with distinct pronotal fold; vein 1-SR of fore wing differentiated with first discal cell present because of presence of vein 1-SR+M; [vein 1-Mand vein 2-SR straight or nearly so]. Medium to large size (length of body above 20 mm), temple without pale yellowish streak behind eye. Amami-Oshima Is (genus *Megischus*) .....***Megischus baogong* Ge & Tan, sp. nov.**

Genus *Megischus* Brullé, 1846

Megischus Brullé, 1846: 537. Type species (designated by Viereck 1914): *M. annulator* Brullé, 1846 [= *M. furcatus* (Lepeletier & Serville, 1825)].

Megischus Brullé, 1846: van Achterberg 2002: 53–168; Aguiar and Johnson 2003: 469–482.

Bothriocerus Sichel, 1860: 759. Type species: *Bothriocerus europaeus* Sichel, 1860 (by monotypy) (= *Stephanus anomalipes* Foerster, 1855, according to Madl 1991).

Diagnosis. Medium to large size. Temple without pale yellowish streak behind eye. First subdiscal cell comparatively narrow basally, approximately as wide as first discal cell or narrower; vein 1-SR of fore wing differentiated with first discal cell present because of presence of vein 1-SR+M; veins 1-M and 2-SR straight or nearly so. Dorsal tooth of hind coxa absent; hind femur with two distinct teeth; hind tibia narrowed basally and inner side usually with wide sub-medial depression, without oblique striae or rugae on outer side; hind tarsus with three tarsomeres. Metasomal sternum I united with tergum I; Ovipositor sheath with ivory subapical band.

Distribution. Cosmopolitan.

Megischus baogong Ge & Tan, sp. nov.

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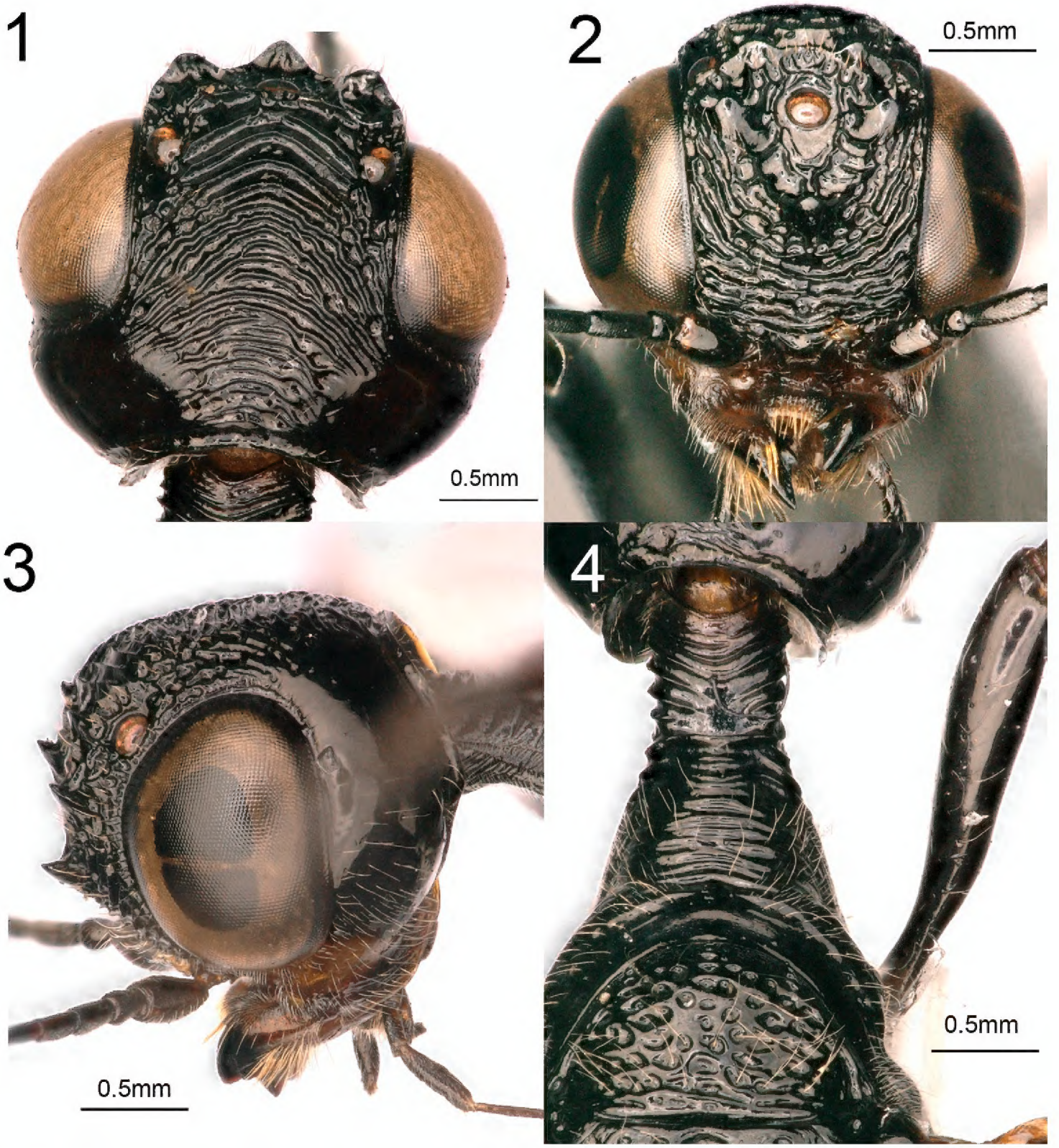
Figs 1–16

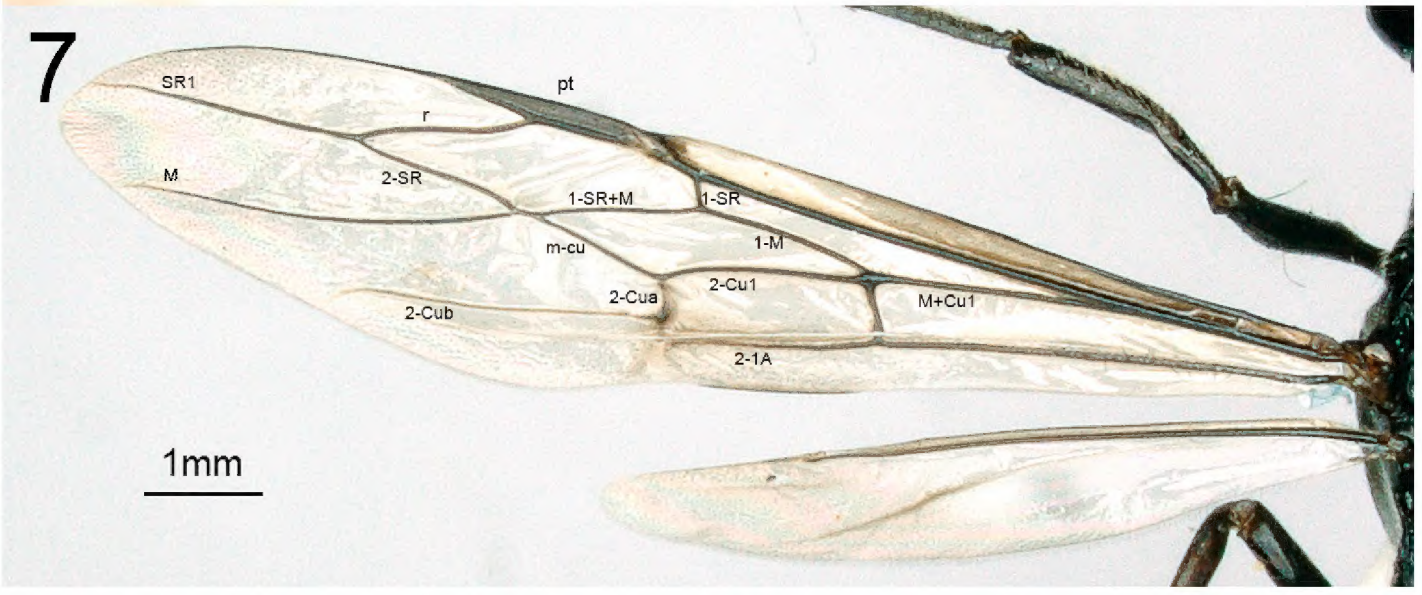
Material examined. ***Holotype***, ♀ (BFU), Ryukyu islands: Amami-Oshima Island, Amami City, Naze-shi; 22.VI.2021, leg. Miyamoto toshiiki; ***Paratype***, ♀ (NWUX), Ryukyu islands: Amami-Oshima Island, Amami City, Naze-shi; 22.VI.2021, leg. Miyamoto toshiiki.



Figures 1–4. *Megischus baogong* Ge & Tan, sp. nov. Holotype ♀. **1** head, dorsal view **2** head, frontal view **3** head, lateral view **4** pronotum, dorsal view.

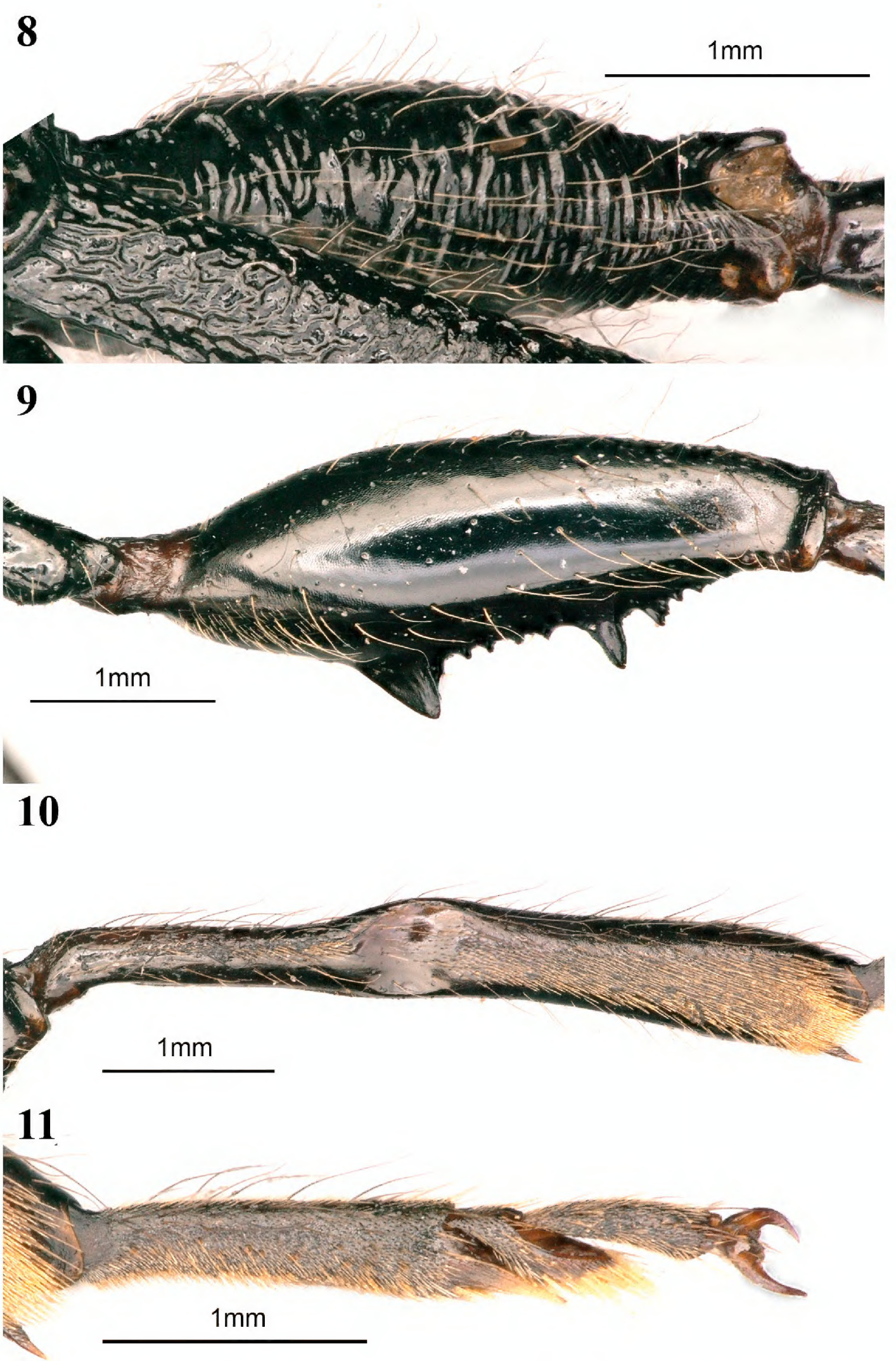
Etymology. The species name is derived from a historical personage, Baogong, a minister in Song dynasty of China famous as a representative of justice, whose drama role named Heimian (black head), a special facial sketch in Chinese opera. We name the new species after Baogong because of its completely blackish head.

Diagnosis. Head completely blackish (Fig. 16), temples slightly bulging behind eyes; ocellar area (Fig. 1) transversely rugose; vertex transversely rugose and posteriorly almost reaching occipital carina; pronotum (Fig. 4) shallowly concave anteriorly and with distinct pronotal fold; area in front of pronotal fold largely smooth; scutellum (Fig. 5) almost glabrous and sparsely foveolae.



Figures 5–7. *Megischus baogong* Ge & Tan, sp. nov. Holotype ♀ **5** mesosoma, dorsal view **6** mesosoma, lateral view **7** wings.

Description. ***Holotype.*** **Female.** Length of body 27 mm; forewing length 14.5 mm; ovipositor sheath 31.5 mm. ***Paratype.*** **Female.** Length of body 24.6 mm; forewing length 12.1 mm; ovipositor sheath 25.3 mm.



Figures 8–11. *Megischus baogong* Ge & Tan, sp. nov. Holotype ♀ **8** hind coxa, lateral view **9** hind femur, lateral view **10** hind tibia, lateral view **11** hind tarsi, lateral view.

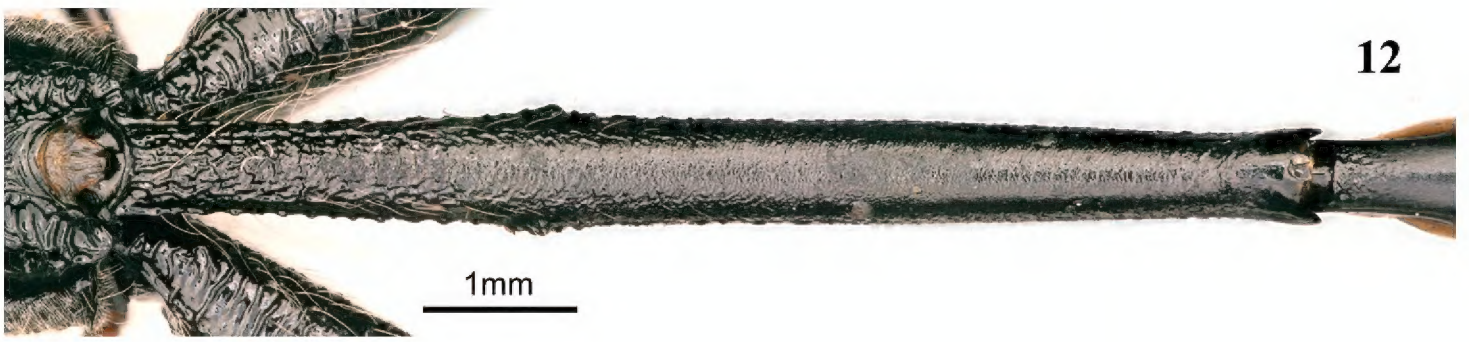
Head. Antenna with 41 segments; first antennal segment 1.5× as long as wide and 2.1× as long as second segment, third segment length 2.7× its maximum width; frons strongly rugose, more or less reticulate-rugose medially (Fig. 2); three anterior coronal teeth large and lobe-shaped, both posterior ones smaller and wider; vertex with 3 strongly curved carinae anteriorly, followed by slightly reticulate-rugose medially and transverse rugae almost reaching occipital carina; temple slightly bulging, smooth and shiny (Fig. 1), except for some fine punctures laterally; occipital carina distinct, strongly developed up to near level of ventral 0.5 of eye and not connected to hypostomal carina; hypostomal carina large, with several rugae and punctures (Fig. 3).

Mesosoma. Neck relatively slender and anteriorly shallowly concave (Fig. 4), with several weak carinae anteriorly and three interrupted but rather strong carinae, below the middle of the pronotum postero-dorsally. Pronotal fold distinct and with area in front of fold largely smooth and shiny; middle part of pronotum moderately transversely carinate, without lateral groove; middle part of pronotum weakly differentiated from posterior part (Fig. 4), and latero-posteriorly rather weakly convex; posterior part of pronotum generally with rather sparse setosity, propleuron coriaceous; prosternum densely foveolate and setose; convex part of mesopleuron strongly foveolate and with dense whitish setosity (Fig. 6); mesosternum largely smooth (except some fine punctures); scutellum smooth and shiny except some foveolae (Fig. 5); propodeum dorsally almost glabrous (Fig. 5), completely with large, circular foveolae, most foveolae well separated by relatively large interspaces.

Wings. Fore wing: wing membrane subhyaline (Fig. 7), and surface evenly bristly; vein 1-M moderately curved, 5.2–5.6× as long as vein 1-SR and 1.2–1.3× vein m-cu; vein 2-SR 0.95–1.0× as long as vein r; vein r ends 0.5× length of pterostigma behind level of apex of pterostigma; vein 1-SR 0.6–0.7× as long as parastigmal vein; vein 3-CU1 distinct and curved apically.

Legs. Hind coxa strong, annular, largely transversely striate, with long whitish setosity (Fig. 8); hind femur robust, largely smooth and shiny with scattered punctures (more densely developed basally; Fig. 9), hind femur ventrally with two large teeth and four minute teeth in between and one tooth behind large posterior tooth; hind tibia slender, moderately curved basally (Fig. 10), 1.3× longer than hind femur, densely setose, basal narrow part of hind tibia 0.7× as wide as widest part, lateral view of hind tibia below depression nearly parallel-sided and slender, inner side rather convex basally, densely setose; hind basitarsus subparallel-sided, densely setose ventrally, ventral length 4.4–4.9× its maximum width (Fig. 11).

Metasoma. Tergite I with its basal 0.3 reticulate-rugose and remainder part micro-sculptured (Fig. 12), dorsally slightly convex at basal 0.4, ca. 9.2× as long as its maximum width, 2.5× as tergite II and 0.9× as remainder of metasoma; basal 0.05 of tergite II shiny and following 0.1 weakly rugose, remainder coriaceous; remainder of tergites (Fig. 13) smooth and coriaceous with sparse and short setae (but tergite VI and VII densely setose medially); pygidial area with rather fine wrinkled dorsally, medially moderately convex and distinctly punctate; length of ovipositor sheath ca. 1.16× as



Figures 12–15. *Megischus baogong* Ge & Tan, sp. nov. Holotype ♀ **12** Tergite I, dorsal view **13** metasoma (except tergite I), lateral view **14** distal part of ovipositor and sheath, lateral view **15** apex of ovipositor, lateral view.

long as body length and ca. 2.2× forewing length, length of subapical whitish band (Fig. 14) 1.2× as long as dark apical part. Ovipositor tip laterally compressed, with minute teeth apically (Fig. 15).

Colour. Body almost completely blackish; mesosoma, metasoma, antennae, and hind legs black or blackish; head almost completely blackish except brown hypostomal flange; tergite II brownish bilaterally; wing membrane light brownish, subhyaline; fore and middle legs dark brown or blackish; ovipositor sheath largely black except whitish subapical band.

Male. Unknown.

Distribution. Amami-Oshima Island (Ryukyu Islands)

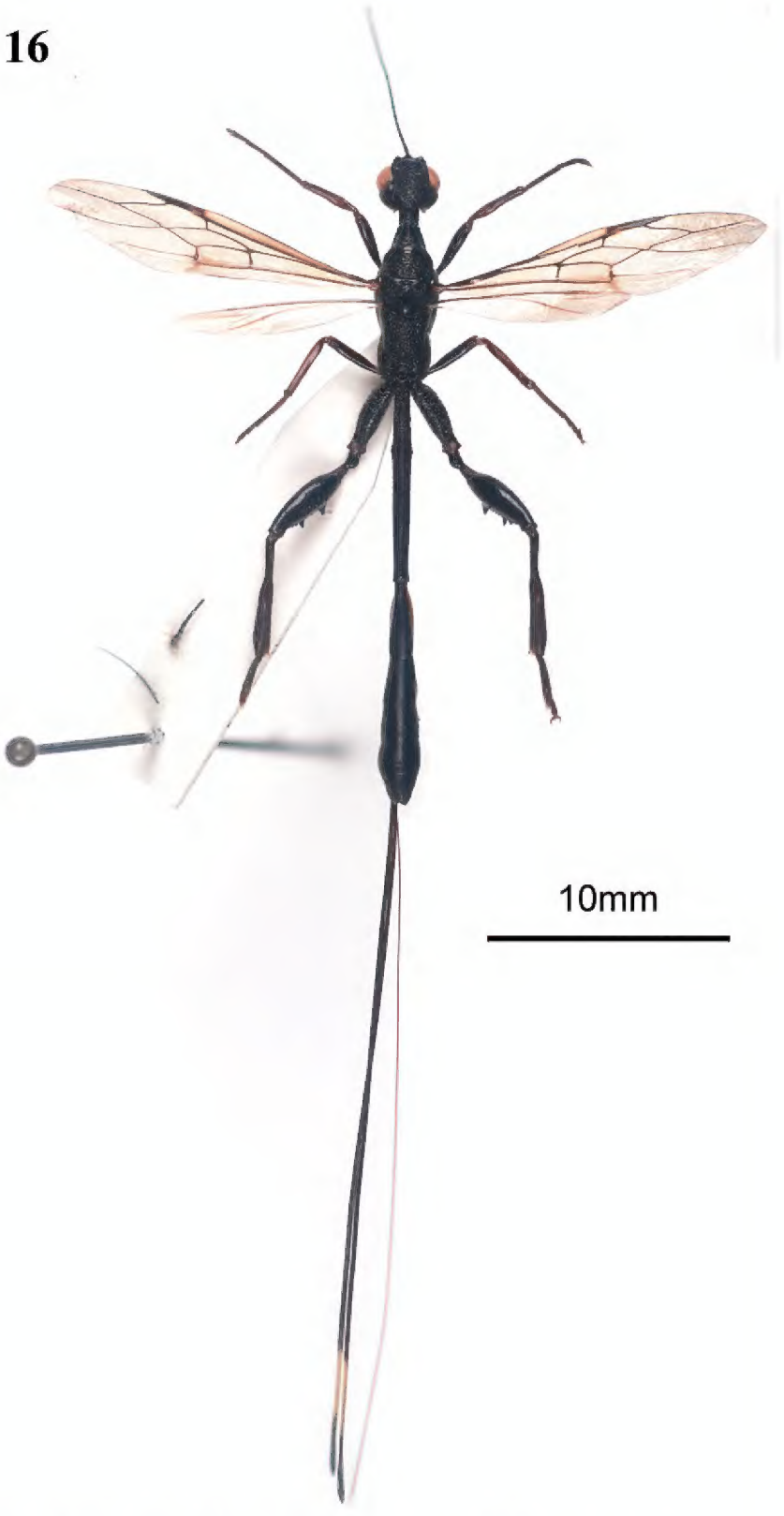


Figure 16. Habitus of holotype. ♀ *Megischus baogong* Ge & Tan, sp. nov.

Biology. Collected in June. Host is unknown.

Note. The new species runs to *M. atriceps* in the key to Old World *Megischus* by van Achterberg (2002), in having the occipital carina not reaching the hypostomal carina and length of subapical whitish band of ovipositor sheath 1.2× as long as its dark apical part. It differs from *M. atriceps* in having a sparsely rugose hypostomal flange, and an almost completely blackish colour of not only head but also legs.

The East China Sea area (including most of the Okinawa Trough) may have been subaerial between 1.6–1.3 Ma, thus indicateing that the Ryukyu Arc region may have been part of the Eurasian continent at that time. During two major development periods (sometime between 1.6 – 1.0 Ma, and 0.2 – 0.025 Ma) the Ryukyu Arc may

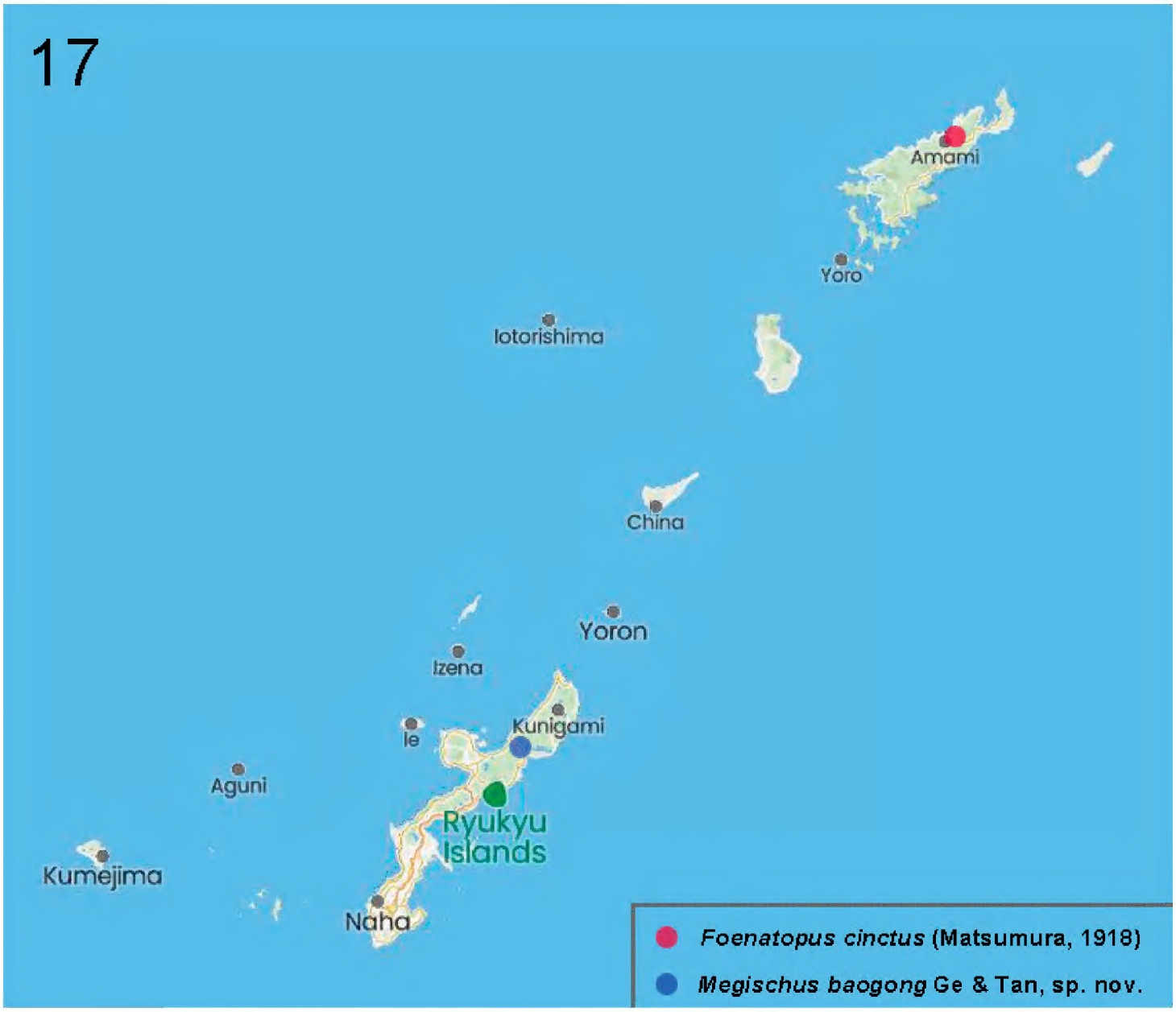


Figure 17. Distribution map of Stephanidae species from Ryukyu Islands (map of Ryukyu Islands from: https://mapcarta.com/16056936).

have been nearly connected to the Chinese continent through Taiwan as a land bridge (Kimura, 2000), as reflected by a similar fauna composition and other characteristics of South China. *Foenatopus cinctus* (Matsumura, 1918) has been found in both Okinawa island and South China (Taiwan and Guangxi), but to date, no *Megischus* species have been recorded from Taiwan. The Ryukyu Islands are located in the subtropical zone, a suitable climate type with the highest diversity of *Megischus* and other Stephanidae. However, including this study, only two species of crown wasps have been recorded for this area. More species can be expected after more intensive collecting.

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